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NP-33-03-011-01

Docket No. 50-346

License No. NPF-3

January 5, 2004

United States Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Ladies and Gentlemen:

LER 2003-011-01
Davis-Besse Nuclear Power Station, Unit No. 1
Date of Occurrence – September 17, 2003

Enclosed please find Revision 1 to Licensee Event Report (LER) 2003-011. LER 2003-011 was submitted to provide written notification of the violation of the Technical Specification 3.0.4 in which the transition from Mode 5 to Mode 3 occurred with an inoperable Containment Spray Pump. Two Containment Spray Pumps are required to be operable in Modes 1 through 4 by Davis-Besse Nuclear Power Station Technical Specification 3.6.2.1 and therefore, this LER is submitted in accordance with 10CFR50.73(a)(2)(i)(B). In accordance with the guidance of NUREG-1022, revision bars have been added to the right margin to denote changes from the previous submittal of LER 2003-011 dated November 17, 2003. This Revision provides an update to the commitments made and the results of an evaluation performed to determine the extent of condition of the Containment Spray Pump false trip. Commitments associated with this LER are listed in the Attachment.

Very truly yours,

AWB/s

Attachments

cc: Regional Administrator, USNRC Region III
DB-1 NRC Senior Resident Inspector
Utility Radiological Safety Board

IE22

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COMMITMENT LIST

The following list identifies those actions committed to by the Davis-Besse Nuclear Power Station in this document. Any other actions discussed in the submittal represent intended or planned actions by Davis-Besse. They are described only as information and are not regulatory commitments. Please notify the Manager - Regulatory Affairs (419-321-8450) at Davis-Besse of any questions regarding this document or associated regulatory commitments.

COMMITMENTS	DUE DATE
Replace the CS Pump 1 breaker that contained the SST system with a breaker without the ground fault function, thereby eliminating the ground fault trip function.	Complete
Replaced CS Pump 2 circuit breaker (following the failure on September 11, 2003). This action effectively placed a different SST system into service (different in this context means that the SST was replaced with the same type of SST which originally existed in the previous breaker).	Complete
Replaced the programmer unit of the SST system on the circuit breaker for the CS Pump 2 with a programmer unit that does not include a ground fault unit.	Complete

NRC FORM 366 (7-2001)	U.S. NUCLEAR REGULATORY COMMISSION	APPROVED BY OMB NO. 3150-0104	EXPIRES 7-31-2004

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
Davis-Besse Unit Number 1	05000346	1 OF 7

4. TITLE

Inoperability of Containment Spray Pump 1 Due to Solid State Trip Device Ground Fault False Trip

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MO	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MO	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
										05000
09	17	03	2003	-- 011 --	01	01	05	2004	FACILITY NAME	DOCKET NUMBER 05000

9. OPERATING MODE	3
10. POWER LEVEL	000

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply)

20.2201(b)	20.2203(a)(3)(ii)	50.73(a)(2)(ii)(B)	50.73(a)(2)(ix)(A)
20.2201(d)	20.2203(a)(4)	50.73(a)(2)(iii)	50.73(a)(2)(x)
20.2203(a)(1)	50.36(c)(1)(i)(A)	50.73(a)(2)(iv)(A)	73.71(a)(4)
20.2203(a)(2)(i)	50.36(c)(1)(ii)(A)	50.73(a)(2)(v)(A)	73.71(a)(5)
20.2203(a)(2)(ii)	50.36(c)(2)	50.73(a)(2)(v)(B)	OTHER Specify in Abstract below or in NRC Form 366A
20.2203(a)(2)(iii)	50.46(a)(3)(ii)	50.73(a)(2)(v)(C)	
20.2203(a)(2)(iv)	50.73(a)(2)(i)(A)	50.73(a)(2)(v)(D)	
20.2203(a)(2)(v) X	50.73(a)(2)(i)(B)	50.73(a)(2)(vii)	
20.2203(a)(2)(vi)	50.73(a)(2)(i)(C)	50.73(a)(2)(viii)(A)	
20.2203(a)(3)(i)	50.73(a)(2)(ii)(A)	50.73(a)(2)(viii)(B)	

12. LICENSEE CONTACT FOR THIS LER

NAME	TELEPHONE NUMBER (Include Area Code)
Aaron W. Bless, Associate Engineer - Licensing	(419) 321-8543

13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX

14. SUPPLEMENTAL REPORT EXPECTED			15. EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE).	X	No				

16. ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)

On September 17, 2003, with the plant in Mode 3, Containment Spray (CS) Pump 1 failed to start on demand and was declared inoperable. Investigation and industry experience determined the most likely cause was due to a false spurious trip of the ground fault function of the circuit breaker overcurrent device. Previous starts have proven to be successful. Prior to September 17, 2003, a previous trip of CS Pump 1 occurred on September 5, 2003 (when the plant was in Mode 5); corrective actions to address that trip, however, did not address the problem with the Solid State Trip (SST) ground fault trip function. CS Pump 1 operated successfully (at least five starts) before tripping again on September 17, 2003. Following the September 17, 2003, trip CS Pump 1 breaker was replaced with a breaker without the ground fault trip function. Technical Specification 3.6.2.1 requires two independent containment spray systems to be operable in Modes 1 through 4. Technical Specification 3.0.4 states that entry into an operational mode or other specified applicability condition shall not be made unless the conditions of the Limiting Conditions for Operation are met without reliance on provisions contained in the ACTION statements unless otherwise excepted. Transitioning from Mode 5 to Mode 3 with CS Pump 1 inoperable was a violation of Technical Specification 3.0.4 and is being reported in accordance with 10 CFR 50.73(a)(2)(i)(B) as any operation or condition prohibited by the Technical Specifications.

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NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)* (17)

DESCRIPTION OF OCCURRENCE:

On September 17, 2003, with the plant in Mode 3 and the Reactor at 0 percent power, a non-nuclear heat-up test of the Reactor Coolant System (RCS) [AB] was in progress. This test consisted of heating the RCS to Normal Operating Pressure and Normal Operating Temperature (NOP/NOT), for approximately seven days (reference Serial 2973 for additional information on the NOP/NOT test). At 0336 hours on September 17, 2003, Containment Spray (CS) Pump [BE-P] 1 was declared inoperable and Technical Specification 3.6.2.1 was entered due to closing the Lower Spray Header Isolation valve during the line-up for recirculation of the Borated Water Storage Tank (BWST) [BP-TK]. A start of CS Pump 1 was scheduled to be performed separate from the NOP/NOT test to obtain various operational data of the CS Pump. However, at 0350 hours, when a start of CS Pump 1 was attempted, the breaker closed and then immediately opened. Therefore, CS Pump 1 remained inoperable following the test due to the failure to start on demand (via remote control switch).

Technical Specification 3.6.2.1, Containment Spray System, requires two independent Containment Spray Systems be Operable in Modes 1 through 4. With one CS System inoperable, Technical Specification 3.6.2.1 requires the inoperable system be restored to operable status within 7 days or initiate a plant shutdown/cooldown.

The Containment Spray System sprays borated water from the BWST into the Containment [NH] atmosphere, after a design basis (full power) loss-of-coolant accident (LOCA), to cool, condense, and reduce the pressure of the post-LOCA Containment atmosphere. After the injection phase of system operation, the system sprays water, which is treated with Trisodium Phosphate to raise the pH of the sump water (to 7), from the Containment Emergency Sump.

In response to the failure of CS Pump 1 to start, a problem solving team which had evaluated a previous breaker failure was re-initiated. The subsequent Problem Solving Plan (for the CS Pump 1 breaker trip) identified four recent occurrences in which either CS Pump 1 or CS Pump 2 failed to start (two occurrences for each, including the September 17, 2003 failure of CS Pump 1).

On July 10, 2003, with the plant in Mode 5, CS Pump 2 motor tripped immediately (first of four recent trips, failure one of two for CS Pump 2) upon startup, during post maintenance testing. CS Pump 2 was declared inoperable. Corrective action for the July 10, 2003 failure of CS Pump 2 was to increase the circuit breaker instantaneous trip set point (this action was implemented on both CS Pump 1 and CS Pump 2 breakers). Based on the observed immediate trip reported by Operations and on actuation of the breaker bell alarm device (which opens or closes when the breaker trips because of overcurrent), the motor winding and cable were tested to verify that a fault did not exist. Because no evidence of a fault existed, it was believed that the CS Pump 2 breaker trip was caused by false operation of the Solid State Trip (SST) instantaneous function.

The SST system protects the CS Pump Motor with the following trip functions: Long-Time, Instantaneous and Ground Fault. The Instantaneous trip protects against short circuits of the motor winding or feeder cable.

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NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)* (17)

DESCRIPTION OF OCCURRENCE (continued):

Following the trip on July 10, 2003, CS Pump 2 was returned to service and operated successfully (at least eight starts) before tripping again on September 11, 2003 (see below).

On September 5, 2003, with the plant in Mode 5, while performing testing, CS Pump 1 failed to start and was declared inoperable (second of four recent trips, failure one of two for CS Pump 1). Corrective action for the September 5, 2003, failure of CS Pump 1 was to increase the circuit breaker instantaneous trip set point again (this action was implemented on both CS Pump 1 and CS Pump 2 breakers). Because 480 volt bus voltages had been increased due to transformer tap changes (reference Davis-Besse LER 2003-007-00) on August 30, 2003, it was believed that the higher bus voltage may have contributed toward a higher initial motor starting current causing the instantaneous trip function actuation.

Following the trip on September 5, 2003, CS Pump 1 was returned to service and operated successfully (at least five starts) before tripping again on September 17, 2003.

On September 11, 2003, with the plant in Mode 5, an attempt to start CS Pump 2 resulted in a trip of the CS Pump 2 breaker (third of four recent trips, failure two of two for CS Pump 2). CS Pump 2 was declared inoperable. A problem solving team was assembled for the failure of CS Pump 2 breaker. Because the two instantaneous trip set point changes had not prevented recurrence of the actuations, the problem solving team believed that the condition was confined to the Solid State Trip (SST) system hardware through the process of elimination. Corrective action for the September 11, 2003, failure of CS Pump 2 was to replace the circuit breaker (the replacement breaker has not failed since it was installed on September 12, 2003). The Problem Solving Team determined that CS Pump 2 could be placed back into service because 1) the replacement breaker contained a different SST system (different in the context that the SST was replaced with the same type of SST that originally existed in the previous breaker) and 2) de-energized testing was performed on the motor and cable from the cubicle and proper insulation values for the CS Pump 2 motor and associated cables was confirmed.

During the trip of CS Pump 2 breaker on September 11, 2003, a 3-phase trace of motor starting current was obtained from monitoring equipment connected to CS Pump 2 when it failed to start. The data obtained indicated that motor starting current appeared to be well within the SST system's instantaneous current set point throughout the starting period. Upon recognizing that the previous CS Pump breaker trips may not have been caused by the SST system's instantaneous trip function, the investigation shifted to the SST ground fault function.

The evaluation performed for these four CS Pump breaker failures determined the most likely cause to be a "false trip" of the ground fault function of the circuit breaker overcurrent device (see Apparent Cause Section). The overcurrent device is a component of the breaker's SST system consisting of current sensors, programmer unit, wiring harness, and flux shift trip device (spring release plunger).

DESCRIPTION OF OCCURRENCE (continued):

As described above, the September 5, 2003, breaker trip identified the failure of CS Pump 1 to start due to an instantaneous trip. Based on subsequent evaluation of the CS Pump 2 September 11 trip, the issue was determined to be the SST ground fault. Therefore, it appears that the SST False Ground Fault Trip susceptibility most likely existed during the transition from Mode 5 to Mode 3 for Containment Spray Pump 1.

Technical Specification 3.0.4 states that entry into an operational mode or other specified applicability condition shall not be made unless the conditions of the Limiting Condition for Operations are met without reliance on provisions contained in the ACTION statements unless otherwise excepted.

Transitioning from Mode 5 to Mode 3 with an inoperable Containment Spray Pump is a violation of Technical Specification 3.0.4 and is reportable in accordance with 10 CFR 50.73(a)(2)(i)(B). 10 CFR 50.73(a)(2)(i)(B) requires reporting any operation or condition prohibited by the plant's Technical Specifications. Because the corrective action for CS Pump 2 (replacement of the circuit breaker) appears to have been effective as evidenced by the 8 successful starts without failure, CS Pump 2 failures are not being reported in accordance with 10 CFR 50.73.

APPARENT CAUSE OF OCCURRENCE:

The cause of the CS Pump 1 failure to start on September 17, 2003, based on investigation and industry experience, has been determined to be the false operation of the circuit breaker SST system. The SST system is believed to have inaccurately sensed and/or processed motor starting current, resulting in a false ground fault trip of the circuit breaker.

A false trip is an unexplained or unwarranted trip of circuit protective device. The SST system on the breaker does not directly sense ground faults. Rather the device calculates ground fault current from vector addition of the three individual phase currents. As stated above, the SST for the CS Pumps had the following trip functions (prior to breaker replacement for CS Pump 1): Long-Time, Instantaneous, and Ground Fault. The Ground Fault trip protects against low-level short circuits to ground. Arcing ground faults can occur that are below the level of the instantaneous setting. The ground fault trip was set at approximately 300 amps with trip time of approximately 0.065 to 0.15 seconds (3.9 to 9 cycles). Because Essential 480 Volt AC busses [ED] E1 and F1 are resistance-grounded with the neutral of the 4160/480 volt delta-Y transformer connected to ground through a 76 Ohm resistor, ground fault current is limited to less than 5 amps through a single fault. The Problem Solving Team determined that the ground fault portion of the SST system provided no substantial protection beyond that of the resistance ground and therefore, it was removed in accordance with the modification process.

During the trip of CS Pump 2 on September 11, 2003 monitoring of the motor starting current data revealed that the breaker opened after about 7 cycles. As stated above, the problem solving team recognized that the breakers tripped within the expected time band for a ground fault trip. It appeared the previous CS Pump breaker trips may not have been caused by the SST instantaneous function, and therefore, the investigation shifted to the SST ground fault trip.

APPARENT CAUSE OF OCCURRENCE (continued):

Although testing was performed, the specific cause of a false ground fault trip is inconclusive. It is believed that the SST overcurrent system may be susceptible to false ground fault trips and that this susceptibility may have been increased when 480 Volt Bus voltage was increased. Other possible contributing factors include:

- Variation may exist between the 3 current sensor input-output characteristics causing the SST to calculate a ground fault current when none exists.
- An anomaly in the programmer may result in inaccurate SST vector addition of the 3 phase currents (calculation of ground fault current).
- Electronic noise may produce or amplify an erroneous SST calculation of ground fault current.
- DC offset of the AC starting current may amplify erroneous SST calculation of ground fault current (this factor is random and depends on voltage wave at time of motor start).

ANALYSIS OF OCCURRENCE:

The Containment Spray System is an engineered safety feature and is provided, in conjunction with the Containment Air Cooling System (CACS) [BK], to perform the safety function to reduce rapidly, consistent with the functioning of other associated systems, the containment pressure and temperature following a loss-of-coolant accident and maintain them at acceptably low levels. The CS System also provides an additional safety function to reduce the concentration of fission products released to the environment following postulated accidents.

The Technical Specification required number of operable Containment Air Coolers (CACs) was met during this occurrence and throughout the time the plant was in Mode 3 and Mode 4 for the NOP/NOT Test. Therefore, the CAC system would have provided a means of heat removal and Containment atmosphere cleanup post-accident while in Mode 3. Also, as stated above, because CS Pump 2 remained operable, the CS System was still capable of performing its safety function with operation of CS Pump 2. The Corrective Action taken (replacing the breaker with a breaker with a different SST system) was effective as verified by at least eight successive starts without failure of CS Pump 2.

The most significant consequence of this false trip is that CS Pump 1 did not start and run upon demand (as occurred on September 5, 2003, and September 17, 2003). Between July 10, 2003 and September 17, 2003, prior to the breaker being replaced without the ground fault function (eliminating the ground fault trip function), CS Pump 1 successfully started at least six out of eight start attempts. This shows that there were successful starts of the CS Pump during this time period.

The unavailability of a CS pump has no effect on the Core Damage Frequency (CDF) because CS is not a system credited for mitigating Core Damage. CS is however, credited in the Probabilistic Safety Assessment (PSA) for the mitigation of releases from containment and consequently the unavailability of a CS pump will increase Large Early Release Frequency (LERF). The increase in LERF is negligible with a single CS pump unavailable. Results of the Level 2 PSA have shown the CS

ANALYSIS OF OCCURRENCE (continued):

system is not significant with regards to either Risk Achievement Work (RAW) or Fussell-Vessely (FV) importance measures. This result is a reflection of the amount of redundancy in containment cooling systems. There are two systems, CS and CACS that provide diverse means of containment heat removal. As a consequence, the LERF importance measures tend to be most significant for support systems, such as Service Water [BI], because loss of these systems can both lead to core damage and loss of all containment cooling. The contribution to LERF caused by individual component failures following a core damage sequence with an independent initiating event, is very low. Therefore, the unavailability of a CS pump for the length of time described in this report will have a negligible effect on Large Early Release Probability (LERP).

The extent of condition for the breaker problem involves General Electric 480 volt model AK-25 metal clad circuit breakers installed in the essential and non-essential 480 volt substations. These circuit breakers (with the exception of the breaker for CS Pump 1) have SST systems installed that include a ground fault function. Based on events and test data, the probability of a false ground trip increases with magnitude and extended duration of inrush current, such as caused by large motors.

The 200 hp CS Pump motor starting current is approximately 1500 amps-rms and is the only load that has experienced false trips. The CS Pump motor is the largest single motor load on either 480 volt bus E1 or F1. The next largest load is the Containment Air Cooler (CAC). These motors are rated 150/40 hp (fast/slow speed). The CACs receive a Safety Features Actuation System (SFAS) signal to start only in the slow speed (40 hp) mode. There have been no known false trips of the CACs in high speed (150 hp) mode, and it is further unlikely that a false trip will occur during an automatic (SFAS) start in slow speed (40 hp) mode. Additionally, four circuit breakers that feed Motor Control Centers (MCCs) were originally identified as being susceptible. However, based on an evaluation performed to determine the extent of condition of CS Pump false trip, the four MCCs were concluded to not be susceptible based on differences in application, event history and electrical load characteristics.

CORRECTIVE ACTIONS:

Corrective action for CS Pump 1 was to replace the breaker that contained the SST system with a breaker without the ground fault function, eliminating the ground fault trip function.

The corrective action performed for CS Pump 2 for the failure on September 11, 2003, was to replace the circuit breaker. This action effectively placed a different SST system into service (different in this context means that the SST was replaced with the same type of SST which originally existed in the previous breaker). This action is considered remedial because present operating practice permits interchanging circuit breakers between cubicles. Although the breaker installed following the September 11, 2003, failure for CS Pump 2 has been tested several times to gain confidence that it would start when necessary, there was no process to ensure that this circuit breaker would not be replaced with a different

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NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)* **(17)**

CORRECTIVE ACTIONS (continued):

breaker/SST combination. Therefore, a preventative action was taken to replace the programmer unit of the SST system on the circuit breaker for the CS Pump 2 with a programmer unit that does not include a ground fault function.

The problem solving team concluded that although the cause of a false ground trip could not be definitively identified, eliminating the ground fault function from the SST would prevent recurrence of the problem. As discussed above, the essential 480 volt AC busses E1 and F1 are resistance-grounded, and fault current is limited to less than 5 amps. Because the ground fault trip is set at around 300 amps it was determined this portion of the SST provides no substantive protection beyond that of resistance ground. The problem solving team recommended that an engineering change be made to eliminate the ground fault function of the SST for CS Pump 1 in conjunction with replacing the breaker (and later, as stated above it was decided to generate a corrective action to replace the SST programmer unit on the circuit breaker for the CS Pump 2 with one that does not contain a ground fault unit).

FAILURE DATA:

There have been no License Event Reports in the past three years submitted from Davis-Besse Nuclear Power Station, reporting an event due to the inoperability of a Safety related piece of equipment due to a "false trip." No other previous similar events are known to have occurred in the last three years for which corrective action could have been expected to prevent this occurrence.

Energy Industry Identification System (EIIS) codes are identified in the text as [XX].

NP-33-03-011-00

CRs 03-07794,
03-05464, 03-07351,
03-07608, 03-10376